cluster is perhaps thus to be explained. But there is evidence that the glabrate plant grew on Nantucket long before any effort had been made to introduce the heather there. The Herbarium of Columbia University contains another old specimen of *Calluna* labeled simply "Nantucket" without other record. It belongs among the earlier collections of the heather on that island and is of the glabrate form. It would seem to be most unlikely that both forms had come to the island together from the same place in Europe, and it is therefore to be inferred that Nantucket has received this addition to its flora from at least two sources of origin. Indeed Mrs. Owen believes (loc. cit.) that a solitary plant of *Calluna* found on Nantucket in 1880 far away from the locality where it was brought in with European conifers three years before was not of that introduction. How it came there is not less a mystery than is the presence of the heather at the other widely separated localities from Newfoundland to New Jersey where it has been found on the American Continent.

NEW YORK CITY.

TWO NEW SPECIES OF STIGONEMA.[1]

FRANK N. BLANCHARD.

(Plate 105.)

IN some material collected in October, 1909, by Dr. F. D. Lambert of Tufts College, from Chebacco Pond in the town of Essex, Essex County, Massachusetts, there was found very abundantly a blue-green alga, that apparently had not been described before, belonging to the family *Stigonemaceae*. This material was put into formalin and left until November, 1912, when Dr. Lambert and myself secured fresh material from the same place and found the same alga still plentiful. In April, 1913, I visited the pond and found the alga very scarce, but in exactly the same growing condition as in the previous November. It was found free-floating among other algae, chiefly blue-greens, where dead leaves and stems had collected in masses at the edge of the pond. Its filaments form loose, wiry-looking clusters from one to several millimeters in diameter.

[1] Contributions from the Biological Laboratories of Tufts College, No. 55.

The plant in the vegetative condition consists of blue-green filaments, 20–36 microns wide, that are repeatedly branched in every direction. Occasionally three or four branches may arise from adjacent cells, but the branches are usually more scattered. Although it is usually true that a branch is narrower than the filament it comes from, it may be equal to it in width, but never greater. In all the material collected the majority of branches appeared to be developed for the sole purpose of forming hormogones. No free vegetative ends of filaments, that were not forming or that had not already formed hormogones, were observed in all the material examined. The filaments are usually composed of a single row of cells, but two cells very frequently occur side by side. The colorless connections between the cells are plainly shown in formalin preserved material (fig. 8).

Lateral heterocysts are common (fig. 3). Intercalary heterocysts often occur just below a hormogone, and sometimes in other places, but they are less common than the lateral heterocysts. They contain no granules and vary in color from a light brown to a very dark blue.

The sheath is usually colorless, but many times is tinged at the ends of branches with a light, golden brown. The sheath varies from four to eight microns in thickness.

Filaments grow in length and develop branches by simple division of cells. Early stages in formation of a branch are shown in figures 1, 2, and 3. Hormogones are found of all lengths up to 196 microns, and their width is the same as that of the vegetative cells. They are developed in special branches and at the ends of main branches; they may occupy the whole of a branch and project down into the main filament, or may occupy only a part of the branch (figs. 3 and 6). When the plant is most actively forming hormogones, the vegetative cells become more and more vacuolated (figs. 1, 2, 3, and 6), and after the hormogones have escaped, the vegetative cells, sometimes if not always, degenerate. In one plant observed, every hormogone had escaped, and the sheath and cells had become a uniform brown, showing evident degeneration after escape of hormogones. Intermediate stages in this degeneration are easy to find.

The hormogones escape by a breaking off of the end of the sheath as in figure 6, or by apparent disorganization of the end of the sheath. The actual discharge of the hormogone is a slow process and appears to be accompanied by the discharge of a mucilaginous mass (figs. 4 and 5). The hormogone may escape from the sheath as a whole or may break up into groups of one, two or more cells, either before or after leaving the sheath, as shown in figures 4, 5, and 7. In very young hormogones, the line of division between the cells is not clear, but as they grow older this line of separation increases in distinctness. The color of the hormogones changes as they mature, from the light blue-green of the vegetative cells to a very dark blue-green, which under the microscope appears almost black. This is probably due to a concentration of material. For this alga I propose the name

STIGONEMA **anomalum** sp. nov. Filis liberis, inter algas varias sparsis, repetite et irregulariter vel subsecundatim ramosis, 20–36 μ crassis; ramis patentibus, filo primario nunc aequicrassis, nunc tenuioribus, omnibus hormogoniferis; vagina 4–8 μ crassa, continua, hyalina vel ad apices aureo-fusca; cellulis diametro brevioribus, rectangularibus vel disciformibus, uni- vel biseriatis, aerugineis; heterocystis lateralibus, rarius intercalaribus, fuscis vel coeruleis; hormogoniis terminalibus, longitudine variis, usque ad 196 μ, aerugineis.

Filaments unattached, floating among other algae, repeatedly branched in every direction, or somewhat secundly, 20–36 μ diam.; branches patent, of the same size as the primary filament or sometimes thinner, all producing hormogones; sheath 4–8 μ thick, even, hyaline or sometimes golden brown at the apex of a branch; cells shorter than their diameter, mostly disciform or rectangular, of one or two series of cells, blue green; heterocysts lateral, less commonly intercalary, from brownish to blue-green; hormogonia terminal, of varying length, up to 196 μ.

Forming loose clumps, free floating among other, mostly blue-green, algae, Chebacco Pond, Essex, Massachusetts.

S. anomalum is a typical *Stigonema* for the following reasons: It is composed of one or two rows of cells; it is repeatedly branched in every direction; all branches bear hormogones; the cells are usually shorter than wide; the sheath is sometimes colored a light brown. It is allied to *Fischerella* and *Hapalosiphon* by its tendency to unilateral branching; by its smooth sheath; by the first cell of a branch projecting into the main filament; and by its generally rectangular cells.

Stigonema ocellatum is the only plant that could be confused with *S. anomalum.* I examined the specimen labeled *S. ocellatum* collected by G. T. Moore, in 1897 and distributed in Collins, Holden & Setchell, Phyc. Bor.-Am., No. 455, and concluded that my plant was not a new one after all, as it agreed very closely with Moore's plant. I then examined, through the kindness of Mr. Charles Bullard, the specimen of *S. ocellatum* from the Farlow Herbarium, originally from the herbarium of Bornet and Thuret, and decided that Moore had wrongly identified the plant he sent out, and that he had distributed *S. anomalum* under the name of *S. ocellatum.* *S. anomalum* has main filaments of about the size of *S. ocellatum;* as in that species, they consist usually of a single series of cells, occasionally two cells being side by side; otherwise, there is little resemblance. *S. anomalum* differs from *S. ocellatum* in the following ways:

1st. The wall is not very thick; the outline is straight, not following the individual cells.

2nd. There is no lamination either of the general wall, or about the individual cells. This latter, annular lamination, is what gives *S. ocellatum* its specific name.

3rd. The wall is usually colorless; in *S. ocellatum* it is generally colored, sometimes very strongly.

4th. In *S. anomalum* the cells are not rounded, but are mostly disciform.

5th. The branching is repeated, usually with diminution of diameter.

6th. The hormogones are generally longer than in *S. ocellatum.*

7th. The way the branches arise in *S. anomalum* is rather of the *Hapalosiphon* type, the one or two cells in the main filament appearing to belong to the branch rather than to the main filament.

Specimens of *Stigonema anomalum* will be distributed in the Phycotheca Boreali-Americana; the material was preserved in formalin before it was dried, and somewhat shrunken specimens are the result.

In the material collected in 1909, as above described under *Stigonema anomalum,* there was also found a new species of *Hapalosiphon.* Although there is no doubt that it is a *Hapalosiphon*, yet it is even more an intergrading form between *Hapalosiphon* and *Stigonema* than is *S. anomalum.* It was found free-floating under the same conditions as *S. anomalum,* but in appearance it is a small, soft sod a few millimeters across, of a blue-green to brownish color.

In the vegetative condition the plant consists of blue-green or brownish filaments from eight to sixteen microns wide that are repeatedly branched in every direction. There is a tendency for the branching to be unilateral as in *S. anomalum,* and for the secondary branches to be less in number than the primary branches. The branches do not taper toward the extremities, but are sometimes slightly clavate. The branches may or may not be slightly narrower than the primary filament. The cells are nearly always disposed in a single row. The exception shown in figure 9 is rare. All the figures of this plant were made from material preserved in formalin and although there is very little shrinkage, yet there is just enough to show, in many places, the colorless connections between the cells. The cells are mostly cylindrical, usually longer than wide, and closely packed in the sheath. The colorless intercalary heterocysts are common (fig. 10). The sheath is mostly smooth, always colorless, and from two to four microns in thickness. At the ends of hormogone-bearing branches, the sheath is often thickened up to twelve microns (fig. 12). The cells of the branches are sometimes longer than those in the main filament, but are often shorter.

Filaments grow in length and develop branches by simple division of cells as shown in figure 9. Hormogones 37–163 microns in length and 8–12 microns in width occur at the ends of all branches or in short special branches. The cells of the hormogones are not well marked off from each other. Their color remains blue-green throughout their growth. The short hormogone-bearing branches are all variously curved (fig. 10).

Stigonema **medium** sp. nov. Filis liberis, inter algas varias sparsis, repetite et irregulariter vel subsecundatim ramosis, 8–16 μ crassis; ramis patentibus, filo primario plerumque tenuioribus, cylindricis vel clavatis; vagina 4–8 μ crassa, ad apices usque ad 12 μ, continua, hyalina; cellulis plerumque diametro longioribus, cylindricis, uniseriatis, aerugineis vel fuscis; heterocystis forma et magnitudine cellulis normalibus similibus, hyalinis, intercalaribus; hormogoniis terminalibus, 37–163 $\times$ 8–12 μ, aerugineis.

Filaments unattached, floating among other algae, repeatedly branched in all directions or somewhat secundly, 8–16 μ diam.; branches patent, generally thinner than the primary filament, cylindrical or clavate; sheath 4–8 μ thick, up to 12 μ at the ends of the branches, even, hyaline; cells usually longer than their diameter, cylindrical, in one series, blue-green or brownish; heterocysts similar to ordinary cells in form and size, hyaline, intercalary; hormogonia terminal, 37–163 $\times$ 8–12 μ, blue-green.

Forming a minute, soft sod, among other algae, mostly blue-green, Chebacco Pond, Essex, Massachusetts, October, 1909.

This plant shows characteristics of both *Hapalosiphon* and *Stigonema*. It is characteristically a *Hapalosiphon* from its single row of cylindrical cells usually longer than broad; from its method of branching, and in that it usually has the cells in the branches longer than those in the main filament. It has the characteristics of a *Stigonema* in its habit of forming hormogones in the apices of the branches; in the fact that in many of the branches the cells are no longer than those of the main filament or are shorter; in its secondary branching, and in its branching not being distinctly unilateral.

The genera *Hapalosiphon*, *Stigonema*, and *Fischerella* are in many respects alike. In the table on the next page their chief characteristics may be compared at a glance. This table gives a little more latitude than some of the best writers allow; O. Kirchner, for instance, does not admit secondary branching in *Hapalosiphon*. Different accounts of the same species in these genera often vary greatly, but a safe ground has been taken in compiling this table.

It will be seen from this summary that these genera are separated from each other by no clear and definite lines. There are several intergrading forms. The characters that are used to distinguish them are as follows:

Hapalosiphon grows free-floating in fresh water.

Fischerella grows in moist earth, on wet stones, and in hot springs.

Stigonema grows free-floating or on wet stones.

Stigonema is usually much wider than either of the other two; is often composed of several rows of cells, and the cells are usually more rounded than in *Hapalosiphon*.

The branches in *Fischerella* come from a creeping main filament and are unilateral. In *Hapalosiphon*, the branching is unilateral and secondary branching is relatively uncommon, while in *Stigonema* the filaments may be repeatedly branched in every direction. In contrast to *Stigonema*, *Hapalosiphon* has the cells of its branches longer than those of the main filament. A brown or black sheath is characteristic of *Stigonema*, but some of its species have a colorless sheath.

The question now is whether these differences are sufficient to separate three genera, especially after considering the characteristics of the two new plants above described. Bornet and Flahault in "Revision des Nostocacées Hétérocystées," 1887, class those forms now known as *Stigonema* under the subgenus *Sirosiphon*, and treat *Fischerella* as another subgenus of the genus *Stigonema*. Later, 1895, Gomont proposed raising *Fischerella* to the rank of genus, basing his proposal "sur la différenciation très marquée des filaments primaires rampants, relativement aux filaments dressés." West, in "British Fresh Water Algae" considers *Fischerella* to belong with *Hapalosiphon*.

Thus, there has already been considerable difference of opinion as to the relationship of these forms. *Stigonema anomalum* shows simi-

	Reproduction	Width of Filament	Length of Hormogones	Number of rows in Filaments	Style of Branching	Sheath	Cells	Heterocysts
Hapalosiphon	Hormogones and spores; chiefly spores	4 to 24 microns	All lengths	One, rarely two	Chiefly unilateral; secondary branching relatively uncommon	Smooth; colorless	Generally rectangular	Intercalary
Fischerella	Hormogones and spores	6 to 13 microns	Very long	One or two	Unilateral; branches from creeping main filament; no secondary branching	Smooth; colorless	Rectangular, or rounded	Intercalary
Stigonema	Hormogones and spores; chiefly hormogones	7 to 90 microns	All lengths	One, two, or more	In every direction; frequent secondary branching	Smooth or rough; colorless or brown to black	Rounded; less commonly rectangular	Intercalary or lateral

larity to *Hapalosiphon* in that its cells are commonly nearly rectangular; its sheath is smooth; there is a distinct tendency to unilateral branching; and the first cell of a branch usually projects into the main filament as in *Hapalosiphon*. *S. medium* shows itself distinctly like a *Stigonema* in its repeated branching; in the fact that the branches do not taper in the least and are often slightly clavate; and in the fact that hormogones are formed in abundance in all the branches. It also differs from the *Hapalosiphon* in having the cells of the branches often shorter than those of the main filament. It therefore seems necessary to put these three genera together as subgenera of the genus *Stigonema,* and let *Sirosiphon* be the subgenus comprising those forms now known as *Stigonema*. Thus:—

Genus, Stigonema Agardh.

1. Subgenus Sirosiphon Bornet & Flahault.
2. Subgenus **Hapalosiphon** (Nägeli) subg. nov.
   Nägeli ex Bornet & Flahault, Revision des Nostocacées Heterocystées, part 3, p. 54, 1887, as genus.
3. Subgenus Fischerella Bornet & Flahault.

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Explanation of Plate 105.

Magnification: Figures 1 to 8, × 280; 9 to 12, × 420.

Figures 1 to 8 inclusive are *Stigonema anomalum.*

Fig. 1. The beginning of a branch.
" 2. Young branch and intercalary heterocyst.
" 3. Primary filament with short hormogone-bearing branches, unilaterally arranged. Lateral heterocysts and vacuolated cells.
" 4. Escaping hormogones.
" 5. Escaping hormogone.
" 6. A branch after escape of hormogone.
" 7. Hormogones.
" 8. Formalin material showing connections between cells.

Figures 9 to 12 inclusive are *Stigonema medium*.

Fig. 9. Shows that branching is not unilateral; young branch; division of a cell; two cells side by side.
" 10. Hormogone-bearing branch, and heterocyst.
" 11. Escaping hormogone.
" 12. Thickened portion of sheath at end of hormogone.

Agricultural College, Amherst, Massachusetts.

SIX WEEKS' BOTANIZING IN VERMONT,— II.

ADDITIONAL NOTES ON PLANTS NEAR BURLINGTON.[1]

Sidney F. Blake.

Osmunda cinnamomea L. f. incisa (Huntington) Gilbert. Alt. 3670, Mt. Mansfield, 11 August (*Blake* 2733).

Picea mariana (Mill.) BSP. f. **semiprostrata** (Peck) n. comb. *P. brevifolia* var. *semiprostrata* Peck, Spruces of the Adirondacks 12, 13 (1897).— In moss, alt. 3900 ft., Mt. Mansfield, Underhill, 11 Aug. 1911 (*Blake* 2745).— A creeping alpine form of the Black Spruce, eight or ten decimeters long or more, with short crowded branches mostly fascicled toward the erect apex of the stem, and tiny four-grooved glaucous needles 3–6 mm. long.

Sagittaria arifolia Nutt. Mud flats of Lake Champlain, North Ferrisburg, 8 August 1911.

Cyperus strigosus L. f. **capitatus** (Boeckl.) n. comb. *C. strigosus* var. *capitatus* Boeckl. Linnaea xxxvi. 347 (1869–1870). *C. capitatus* Smyth, Trans. Kansas Acad. Sci. xvi. 163 (1899).— Pasture, Cobble Hill, Milton, growing with the typical form.— A form not very well marked, often — as in Boeckler's original specimens — small and seeming only a dwarfed state of the typical plant, but occasionally larger and more definitely distinguished.

Scirpus atrocinctus Fernald f. brachypodus (Fernald) Blake. Pasture, alt. 1400, Mt. Mansfield, Underhill.

S. heterochaetuss Chase. Meadow, North Ferrisburg.

[1] The notes of this list relate to plants collected on several short excursions from Essex Junction, outside the limits of the Burlington Region as defined by Mrs. Flynn.